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Deriving parameters for post-processing from an encoded signal

Abstract:

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(56) Documents Cited
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GB 2326300 A **EP 0656729 A2**
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<URL:http://www.bbc.co.uk/atlantic/montpap.htm>

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(54) Abstract Title
Deriving parameters for post-processing from an encoded signal

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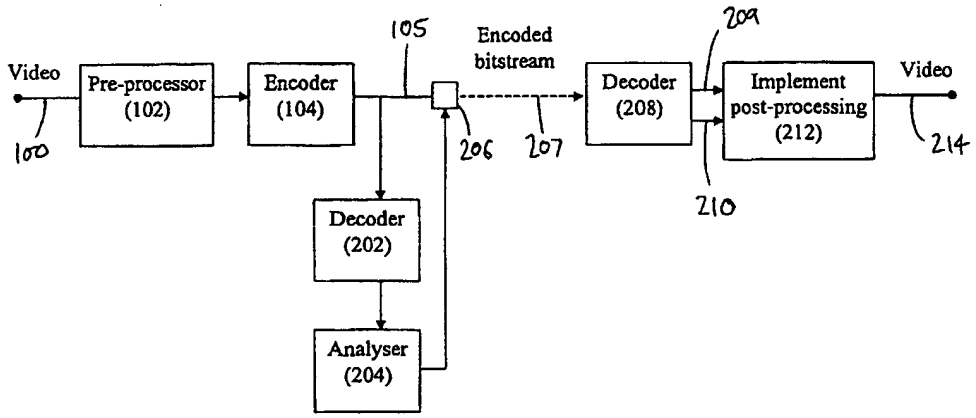

Fig 2

GB 2 365 647 A

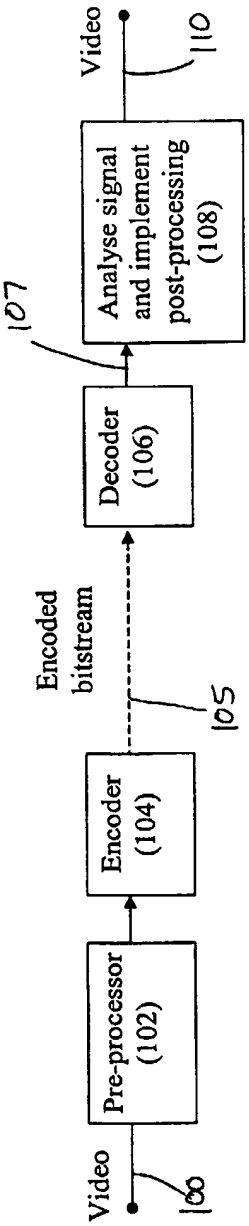
Video
100
Pre-processor (102)
Encoder (104)
Encoded bitstream
105
Decoder (106)
107
Analyse signal and implement post-processing (108)
Video
110

Fig 1

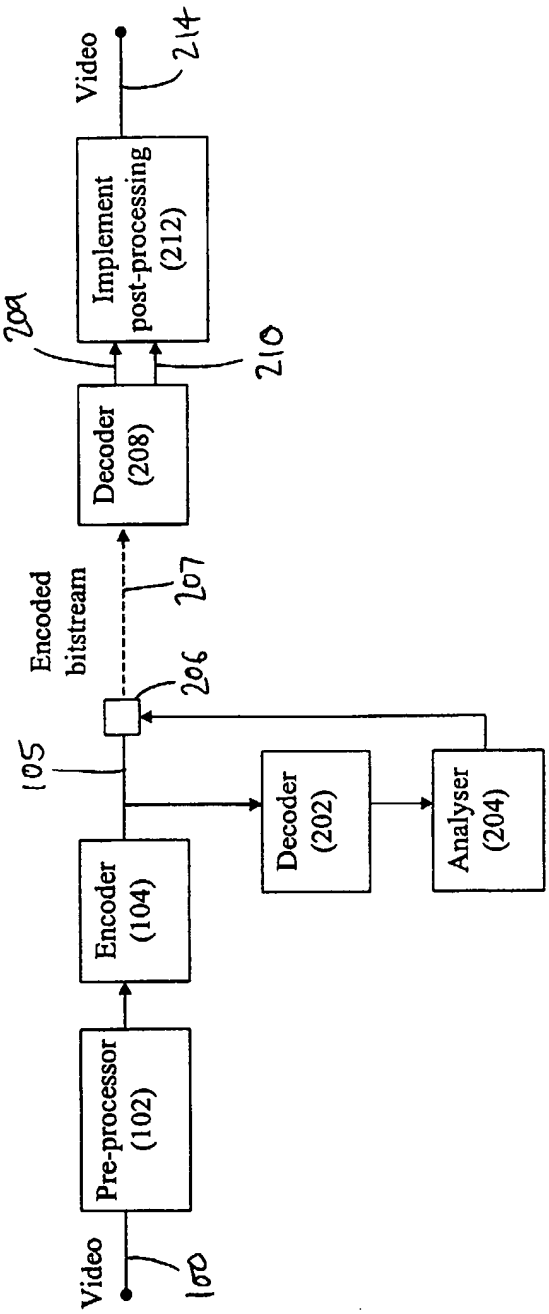
Video
100
Pre-processor (102)
Encoder (104)
105
Encoded bitstream
206
107
Decoder (208)
209
210
Implement post-processing (212)
Video
214
Decoder (202)
Analyser (204)

Fig 2

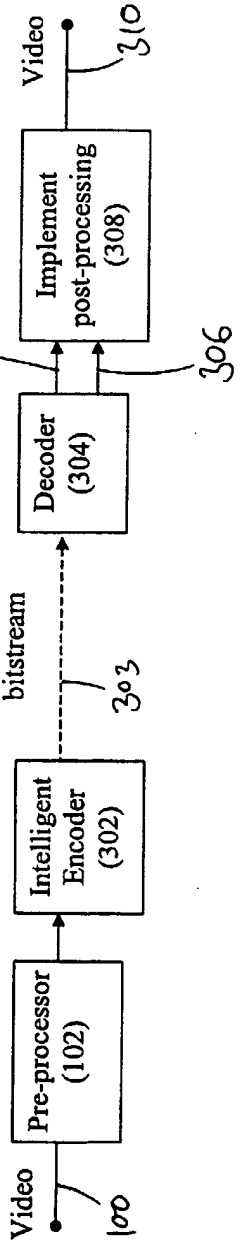
Video
100
Pre-processor (102)
Intelligent Encoder (302)
Encoded bitstream
303
Decoder (304)
305
306
Implement post-processing (308)
Video
310

Fig 3

VIDEO SIGNAL PROCESSING

This invention is directed to the encoding and decoding of video signals.

A number of techniques for encoding and decoding of video signals have been suggested. It has been suggested that such "codecs" employ pre-processing of the video signal before encoding, to remove any image artifacts, such as noise. However, when the signal is encoded, the encoding itself usually introduces other artifacts into the bitstream. For example, many encoders break down the images into a series of blocks in order improve the coding efficiency. When the bitstream is decoded, the blocks defined for the encoding can often be seen in the decoded video images, creating a particularly undesirable artifact. It has therefore been proposed in WO-A-00/22834 that the codecs apply post-processing to the decoded video signal, in order to remove the imperfections introduced by the encoding step.

A post-processor of this type will analyse the decoded video to determine whether any artifacts are present. This step is important, as if a particular post-processing algorithm were used on every signal, it might introduce artifacts rather than removing them. For example, if the suggested block removal method were used on a signal from whose resulting images no blocking was visible, the smoothing employed at block boundaries would introduce more imperfection than was initially present. Once the signal is analysed, the post-processor removes as much of each identified flaw as possible.

The processing involved in these steps can be highly complex, thus increasing the size and intricacy of the decoding equipment. It may therefore not be possible to include this type of post-processing in less sophisticated decoding equipment, such as a household set top box.

It is hence an object of the present invention to provide a simplified encoding and decoding method.

Accordingly, the invention consists in one aspect in a method of encoding and decoding a video signal comprising deriving parameters for post-processing in the encoding and passing the parameters to a decoder adapted to receive the parameters and perform the post-processing.

The complexity of the post-processing step may thus be reduced, allowing for much simpler decoding equipment. The reliability and versatility of the system is also increased, as more of the processing is undertaken at the single encoding "end", rather than at the potential multiple of decoders.

The invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a diagram illustrating a method of encoding and decoding a video signal;

Figure 2 is a diagram illustrating a method of encoding and decoding a video signal according to an embodiment of the invention; and

Figure 3 is a diagram illustrating a method of encoding and decoding a video signal according to another embodiment of the invention.

An arrangement in accordance with WO-A-00/22834 is illustrated in Figure 1. A video signal (100) is passed to a pre-processor (102), in order that certain artifacts present in the signal itself may be removed. Such artifacts might include noise, for example.

The pre-processed signal is then passed to an encoder (104), which produces the encoded bitstream (105). This is then transmitted, for example across a satellite or cable network, to a decoder (106). This produces a decoded video signal (107), which is then passed to block (108). Here, the signal is analysed in order to determine what post-processing is required, and this post-processing is then implemented, producing the video signal (110).

In contrast, Figure 2 illustrates a method of encoding and decoding a video signal according to an embodiment of the invention. The video signal (100) is passed to a pre-processor (102), and subsequently an encoder (104), which produces the encoded bitstream (105). The bitstream is then passed to a decoder (202), and the decoded video signal produced is analysed (204) to

determine what post-processing will be required at the decoder further down the transmission chain. The details of these post-processing requirements are then inserted into the user data of the bitstream (206). The bitstream is then received by a decoder (208), which produces a decoded video signal (209) and passes this, along with the post-processing requirements (210), to the post-processor (212). Here, the derived requirements are simply implemented to produce the video signal (214).

The complexity of the post-processing required after the decoding step is reduced, as the post-processor is not required to analyse the signal. A decoding apparatus employing this method could therefore be reduced in size and complexity, reducing its expense.

A system employing this method would typically have a single encoding "end", following the steps up to the insertion of the post-processing parameters into the bitstream. The bitstream would then be transmitted to a multiple of decoding devices, for example set top boxes, each of which employing the decoder (208) and post-processor (212). There are further advantages in the analysis taking place in the encoding system, rather than in the decoding device. For example, if for a particular video sequence an alteration had to be made to the post-processing involved, this would simply entail modifying the encoding side equipment, rather than having to change each decoder.

Figure 3 illustrates an alternative embodiment of the invention. The video signal (100) is pre-processed as before and passed to an encoder (302). Here, this "intelligent" encoder records, whilst encoding the signal, the artifacts which are being introduced by the encoding, and thus which must be removed after decoding. For example, a particular video sequence may contain a very complex scene, perhaps with fast moving objects. It may be that when this scene is required to be encoded, the information exceeds the buffer capability of the encoder, so that the picture must be encoded more coarsely than the rest of the sequence. In such a case, the more coarse encoding may introduce blocking or other texture artifacts. However, the intelligent encoder notes that the buffer has been exceeded, and in what way the encoding has been made more coarse, and

thus predicts the artifacts which will occur in the decoded video. This information is inserted into the user data of the bitstream (303), so that the downstream post-processor (308) "knows" exactly what processes to implement. The decoder (304) receives the bitstream, producing the decoded video (305). This is then passed to the post-processor (308) with the processing requirements (306), and the processed decoded video signal (310) is produced.

This method has the advantages of the previous embodiment, in that the complexity of the post-processing component at the decode end is reduced, and that the post-processing decisions are taken at the encoder. There is the further advantage that the bitstream need not be decoded and analysed at the encoding end to derive the post-processing requirements. The complexity of the encoding system is thus reduced.

In an implementation of this embodiment, the intelligent encoder is able to remove textures in the video images, in order to increase the compression factor available. In this case, the post-processing requirements inserted into the user data by the intelligent encoder will include notice of which areas of the images the texture removal has been used on. At the decoding end, these areas are identified. If the areas identified contain any high frequency detail, this will be recognised as noise (as the texture has been removed) and thus can be simply removed. There will be other respects in which the control exercised at the encoder of both pre-processing and post-processing can be used to advantage.

In the embodiments described with reference to Figures 2 and 3, the decoder is separate from the simple post-processor following it, and so the post-processing requirements must be passed to the post-processor along with the decoded video. However, in alternative embodiments, the decoder is combined with the post-processor, to form an "intelligent" decoder. Here, the decoder uses the post-processing requirements embedded in the bitstream either during or immediately after decoding to produce the required video output.

In another embodiment, the bitstream is received at the decoding end, but is separated into two signals; the bitstream itself and the post-processing instructions from the user data. The bitstream is then passed to the decoder, and

the decoded video is passed to the post-processor, along with the post-processing instructions signal.

There are many different types of post-processing which may be implemented in the systems described. For example, as proposed in WO-A-00/22834, the decoded video signal is analysed to determine whether any of the borders of the blocks used in the coding are visible in the images. Any sharp edges in the image at the block boundaries are detected by measuring pixel differences across the boundaries. These edges are then "smoothed" by applying a filter to the signal to take an average of the pixels either side of the boundary.

Often, an amount of noise reduction is also required, as the encoder itself can introduce some forms of noise. Wavelet noise reduction, as proposed in GB-A-9909778.4, is a particularly effective method. Here, the signal is divided into a series of frequency bands, and each is processed to determine noise in that band. This enables, for example, high frequency detail in the pictures to be distinguished from "white noise" type artifacts.

It will be appreciated by those skilled in the art that the invention has been described by way of example only, and a wide variety of alternative approaches may be adopted.

CLAIMS

1. A method of encoding and decoding a video signal comprising deriving parameters for post-processing in the encoding and passing the parameters to a decoder adapted to receive the parameters and perform the post-processing.

2. A method according to Claim 1, wherein the post-processing is carried out on the decoded video signal.

3. A method according to Claim 1 or Claim 2, wherein the parameters are derived locally by a decoder and an analyser and passed to a remote decoder.

4. A method according to Claim 1 or Claim 2, wherein the parameters are derived in an encoder.

5. A video signal encoder comprising a video input, an encoded video signal output, means for deriving post-processing parameters and means for embedding the parameters into the encoded signal output.

6. A video signal decoder comprising an encoded video signal input, a decoded video signal output and means for performing post-processing, said means being adapted for control by parameters for the post-processing received with the encoded video signal.

7. A signal comprising an encoded video signal and embedded parameters for the post-processing of the signal after a decoding step.

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Application No: GB 0019241.9 **Examiner:** Ms Ceri Witchard
Claims searched: 1-7 **Date of search:** 30 January 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): H4F FBB FRG FRP FRW FRX

Int Cl (Ed.7): H04N 7/24

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X, E	GB 2349770 A	SONY UK See especially page 3 lines 10-24.	6-7 at least
X	GB 2333656 A	BBC See especially page 2 lines 9-16 and page 3 lines 11-13.	1-7
X	GB 2326300 A	SONY UK See page 2 lines 27-31.	6-7 at least
X	EP 0656729 A2	MATSUSHITA See especially column 10 lines 51 column 11 line 6 and column 11 lines 29-35.	1-7
X	EP 0602817 A2	MATSUSHITA See especially page 4 lines 45-58 and page 19-42.	1-2, 5-7
X	'Seamless Concatenation - A 21st Century Dream' KNEE & WELLS (07.08.97) available via the Internet at <URL:http://www.bbc.co.uk/atlantic/montpap.htm> See 'The Information Bus' on pages 5-6.		1-7

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